Coral Reef Biocriteria

William S. Fisher

U.S. EPA

Office of Research and Development

Gulf Ecology Division

Coral Biocriteria Workshop May 5, 2006

Existing Potential

Substantial expertise and knowledge

- academic, NGO, state and federally-funded programs

Numerous useful bioindicators

- condition, exposure and performance
- coral and non-coral members of the reef community

Monitoring programs

- essential to development of biocriteria

Reef Condition Monitoring Programs

Are coral reefs improving or declining?

Biocriteria Monitoring Programs

Are coral reefs improving or declining *below acceptable levels?*

Biocriteria Monitoring Programs

Are coral reefs improving or declining *below acceptable levels?*

- Determine levels of acceptability
- Employ consistent and defensible methods to document change
- Legal authority to act on results

Biocriteria Development

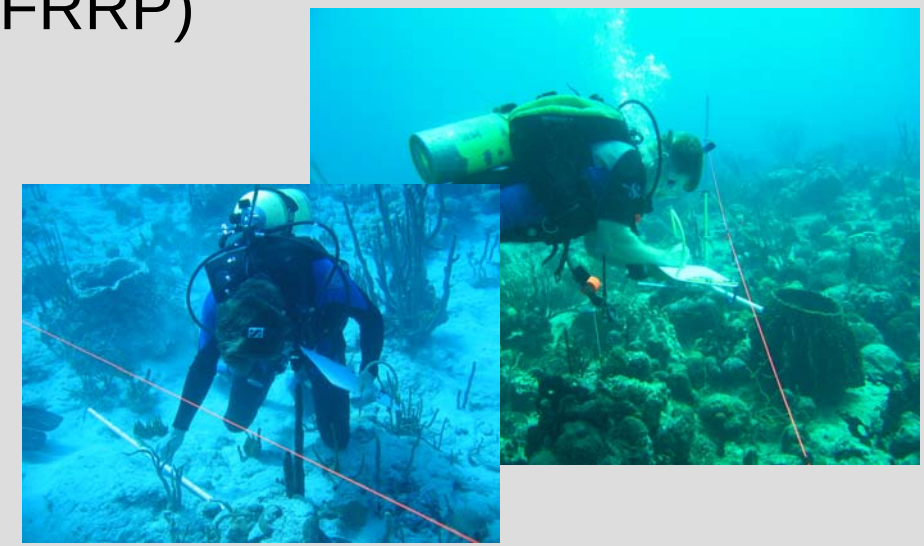
1. Select appropriate metrics
2. Design an effective monitoring program
3. Assign designated uses and define biocriteria
4. Monitor to assure compliance
5. Respond to impaired waters

Supporting Tools

Protocol development

- Review methodology
- Reef classification systems
- Indicator responsiveness (AGRRA)
- Increase efficiency (FRRP)

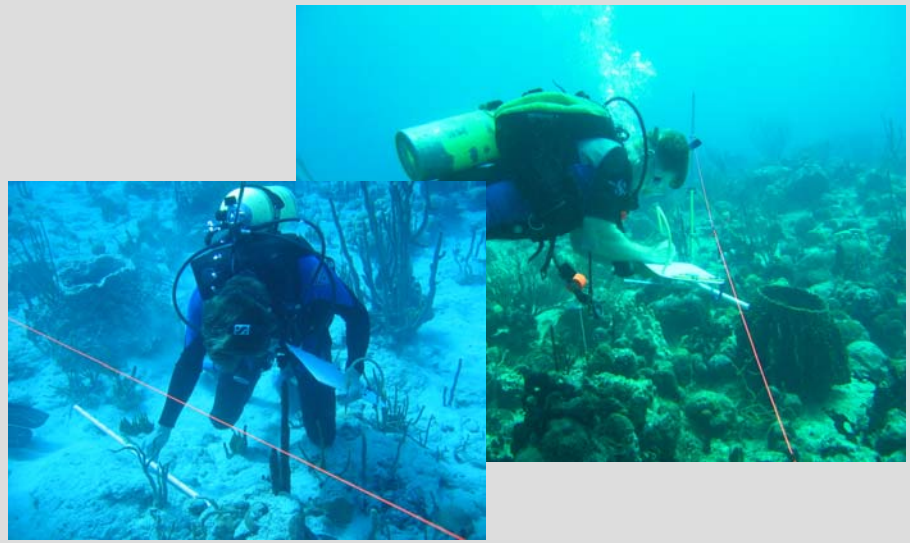
- Stony Coral RBP



Supporting Tools

Global Change Program

- Laboratory studies on UV x T for coral and symbiotic algae
- Model effects of T^o and CO_2 on coral growth
- Influence of climate change on bioindicators and biocriteria



First-Hand Experience

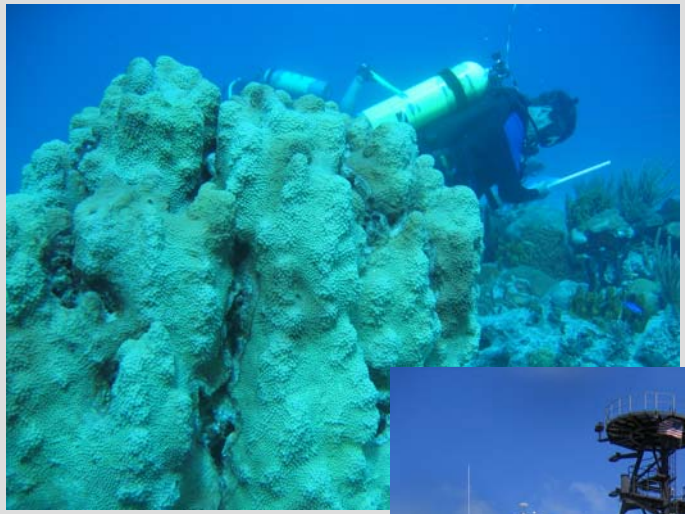
Biological Survey

- Initiate biocriteria development in U.S. Virgin Islands
- Validate a rapid bioassessment protocol and generate an effective monitoring design

St. Croix, U.S. Virgin Islands

Survey Partners

- USVI DPNR
- USVI CZM
- UVI
- US EPA
  - ORD
  - OW
  - Region 2
  - OEI
  - OSP
  - OSV BOLD
- US NPS



Biological Survey

Sampling protocol

- measurements and bioindicators
- optimal sampling unit (transect) size
- measurement error (team variability)

Screen indicators for metrics

Management zones

Reef classifications

Reference conditions

Variability of metrics

Stony Corals

Reef-building corals

- Reef structure
- Community habitat
- Primary production
- Shoreline protection
- Tourism
- Fisheries

Stony Coral Condition Survey

Three field measurements

Colony Identification

Colony Size*

Percent Live Coral

Stony Coral Condition Survey

Three field measurements

Colony Identification

Colony Size*

Percent Live Coral

*Combines colony and surface area approaches by converting colony size to 3D surface area

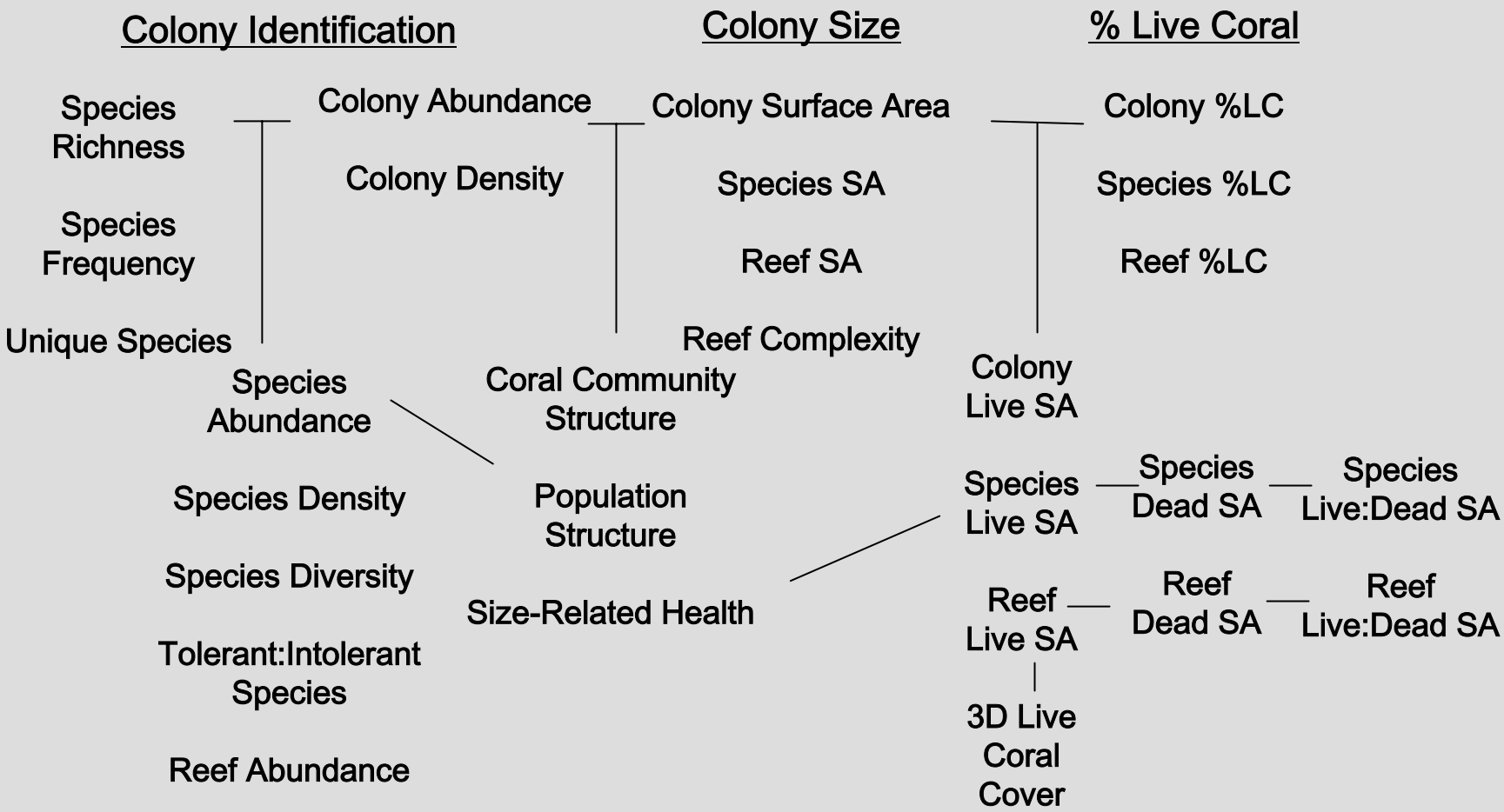
Colony 3D Surface Area

More accurate assessment of coral quantity

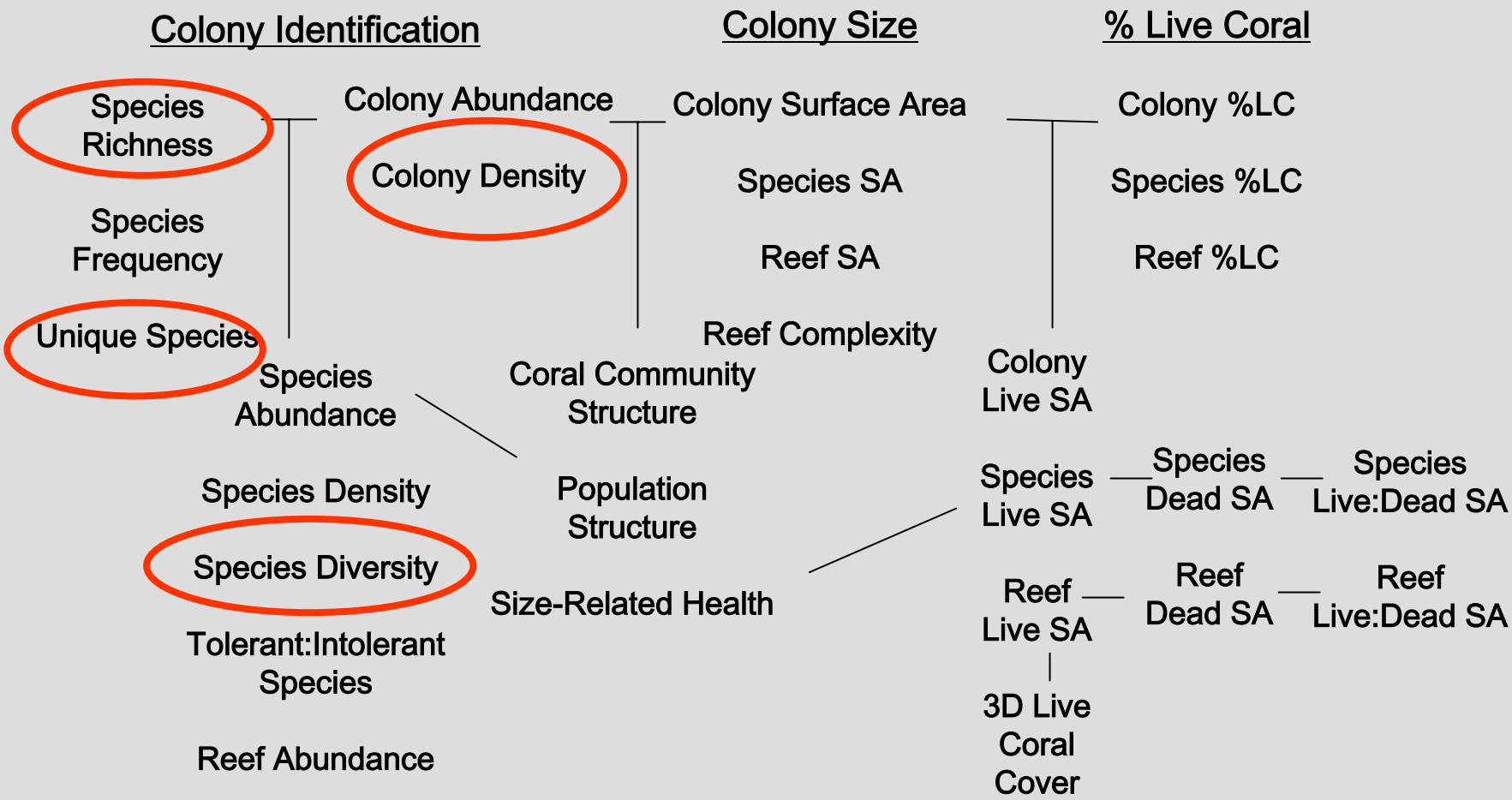
- SA = community habitat
- Capacity for coral growth and reproduction
- Biomass, photosynthesis, $CaCO_3$ deposition

Generates additional bioindicator endpoints to screen for metrics

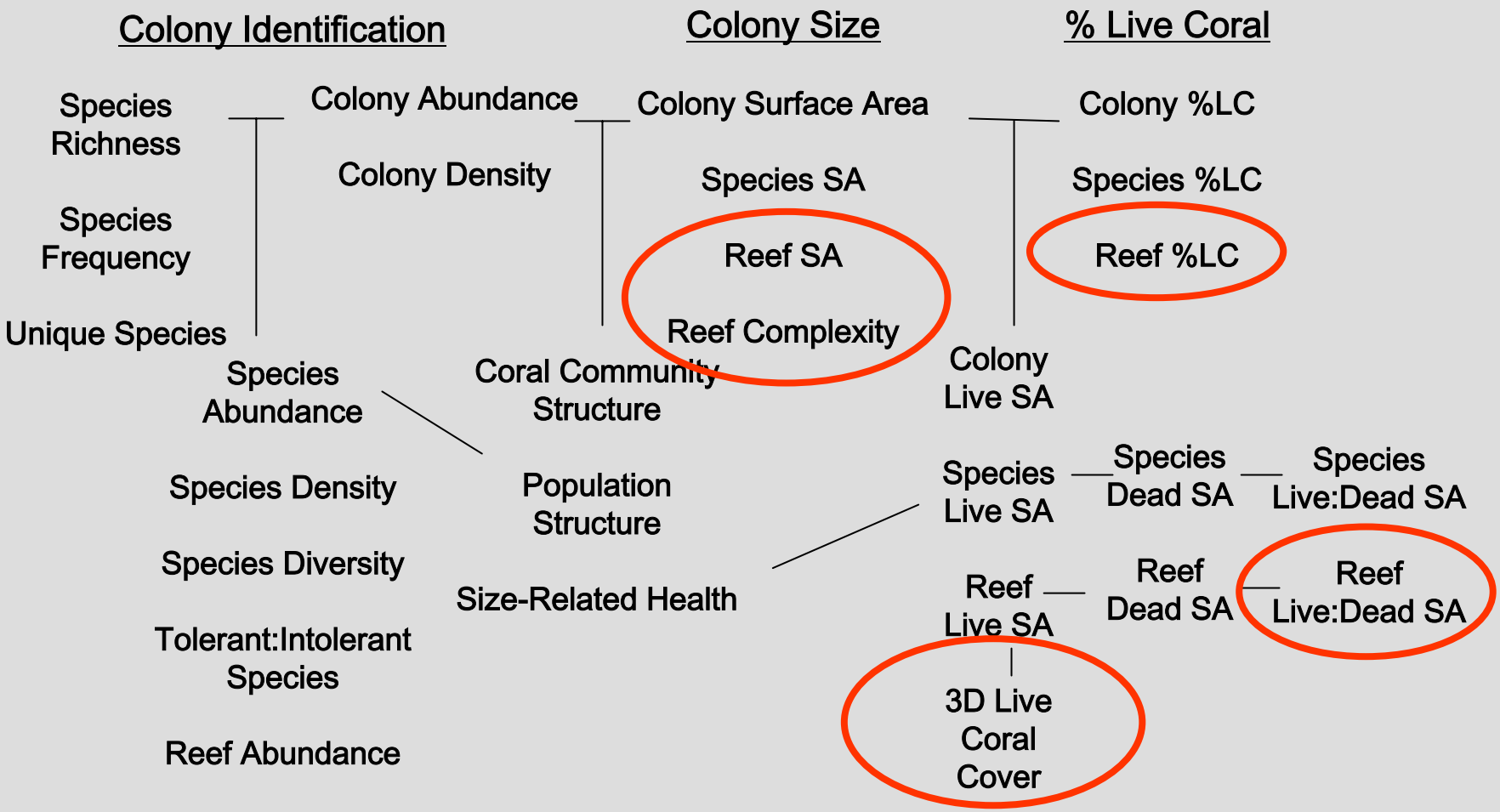
Condition Endpoints



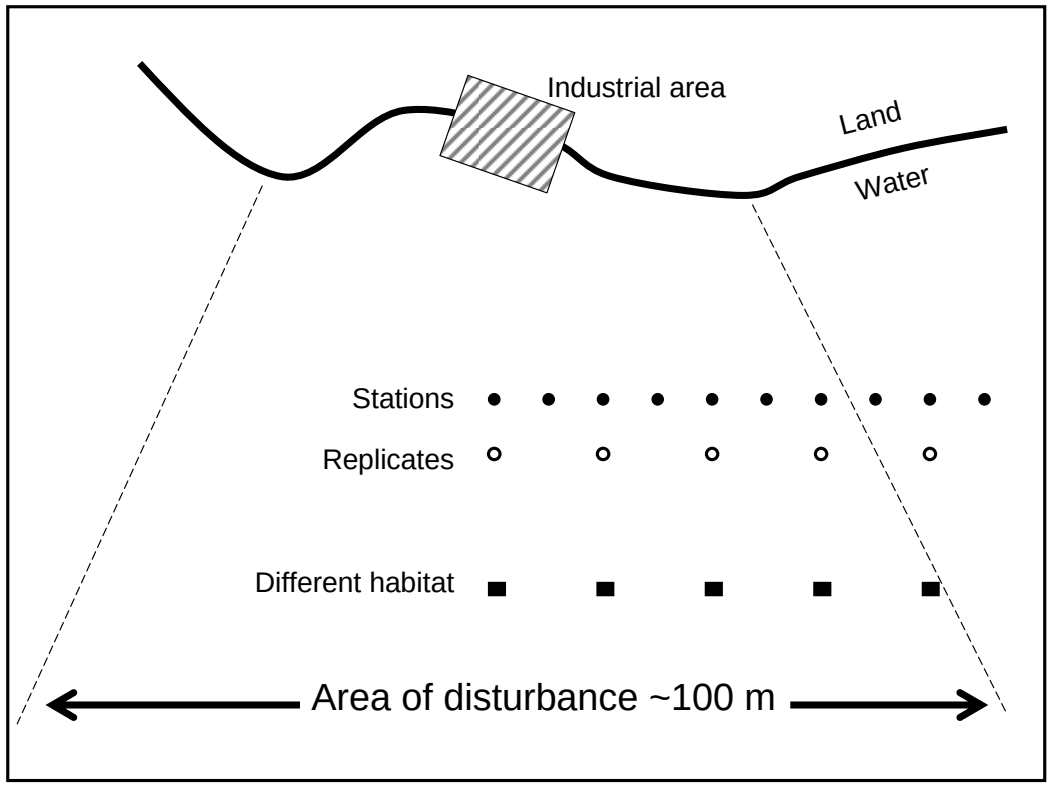
Condition Endpoints



Condition Endpoints

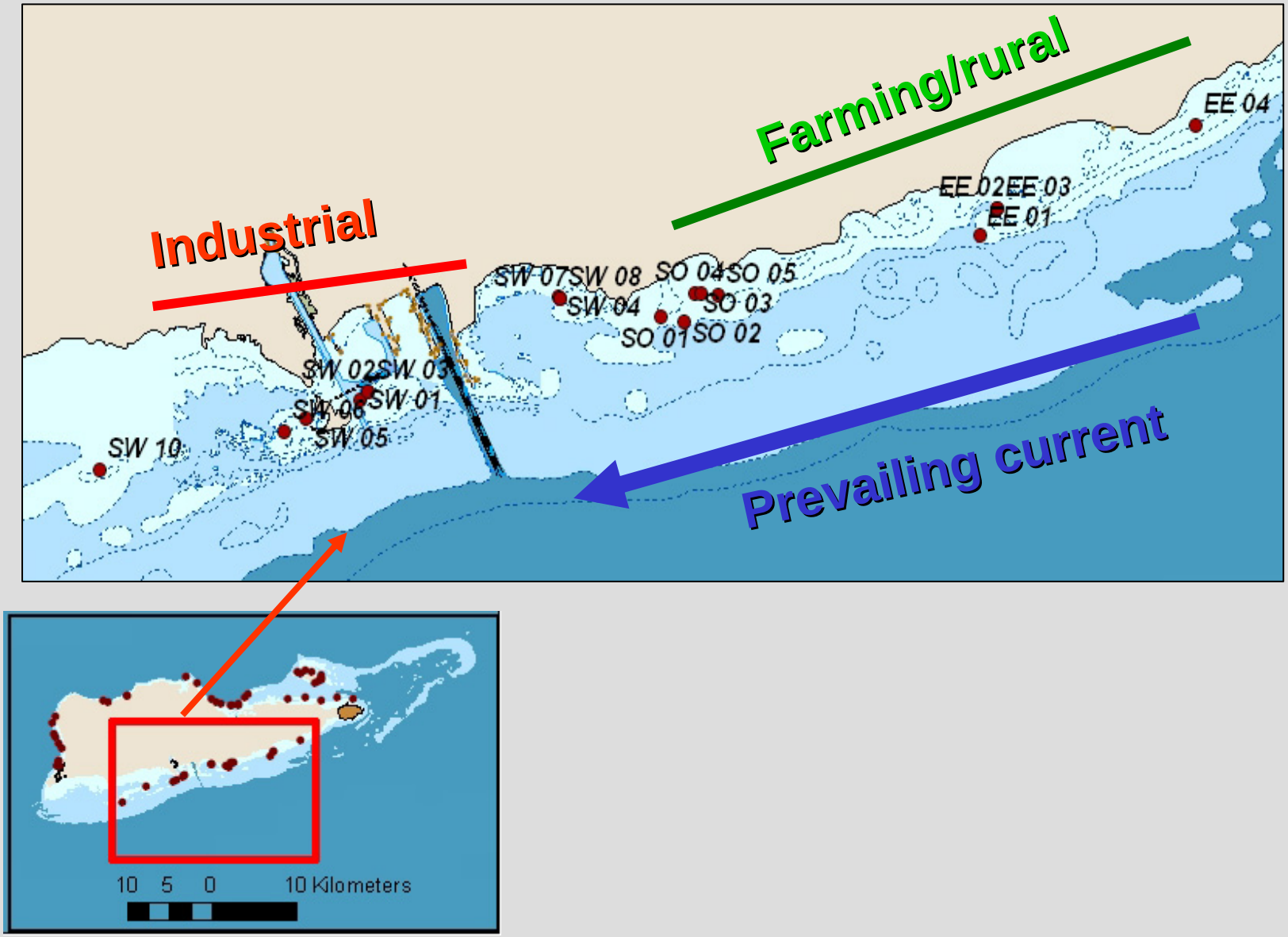


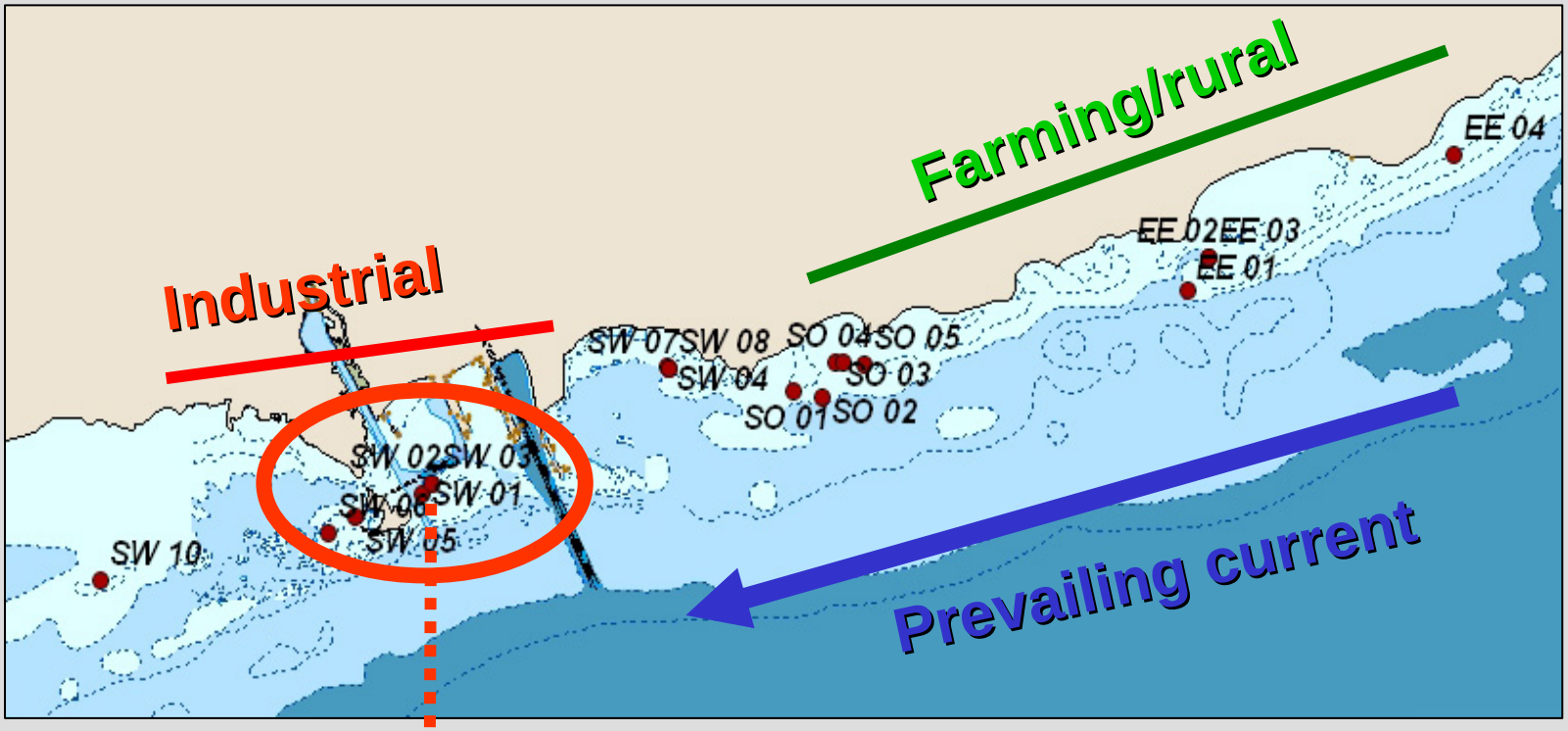
Response to Human Disturbance Gradient



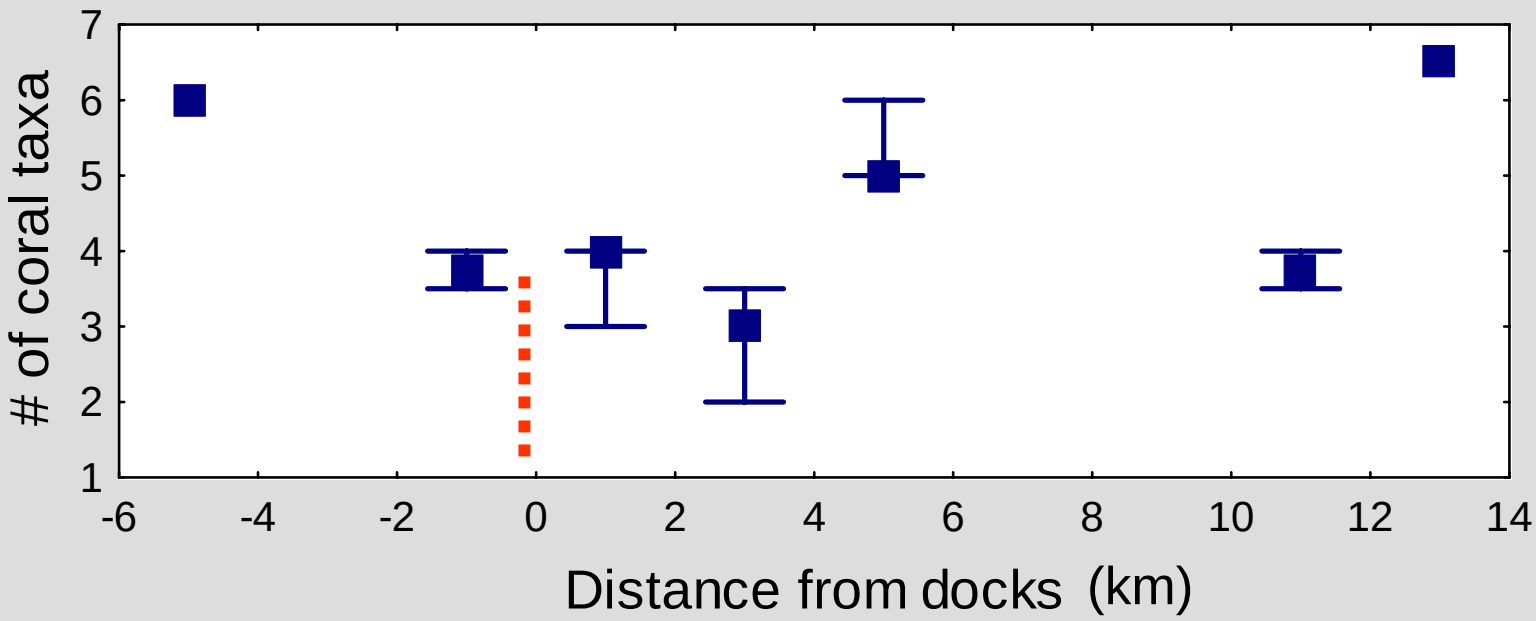
St. Croix Industrial Zone

- shipping, commercial docks
- oil refinery
- sewage outfall
- municipal landfill

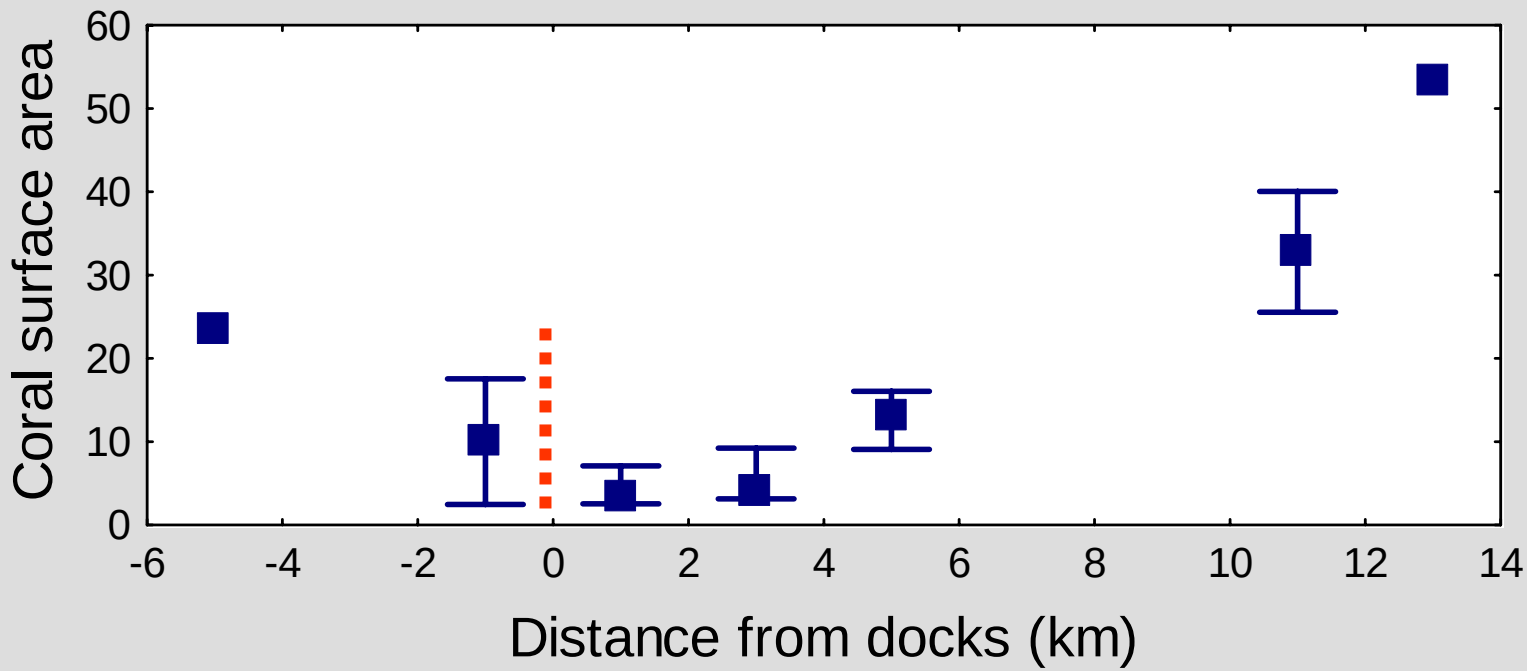

Farming/rural
Industrial
Prevailing current
EE 04
EE 02
EE 03
EE 01
SW 07
SW 08
SO 04
SO 05
SW 04
SO 03
SO 01
SO 02
SW 02
SW 03
SW 06
SW 01
SW 05
SW 10
10 5 0 10 Kilometers


Farming/rural
Industrial
Prevailing current
EE 04
EE 02
EE 03
EE 01
SW 07
SW 08
SO 04
SO 05
SW 04
SO 03
SO 01
SO 02
SW 02
SW 03
SW 06
SW 01
SW 05
SW 10

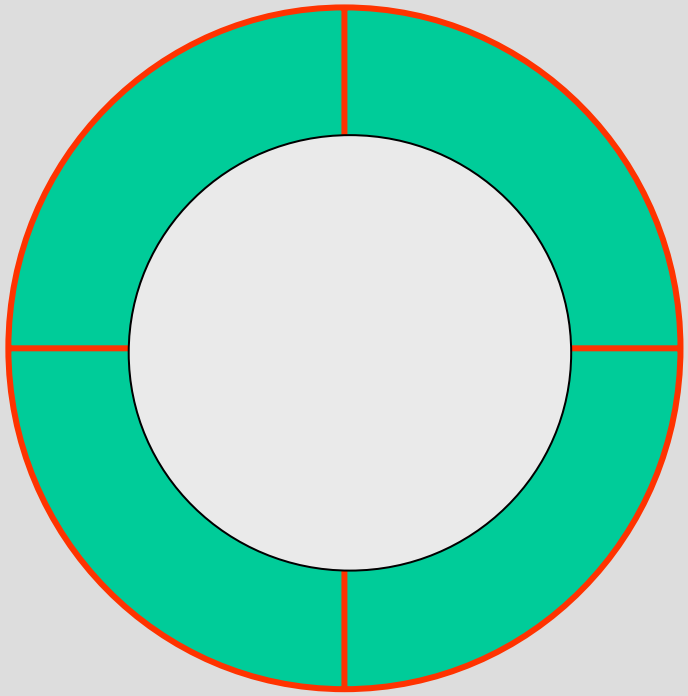
Species Richness



Total 3D Surface Area



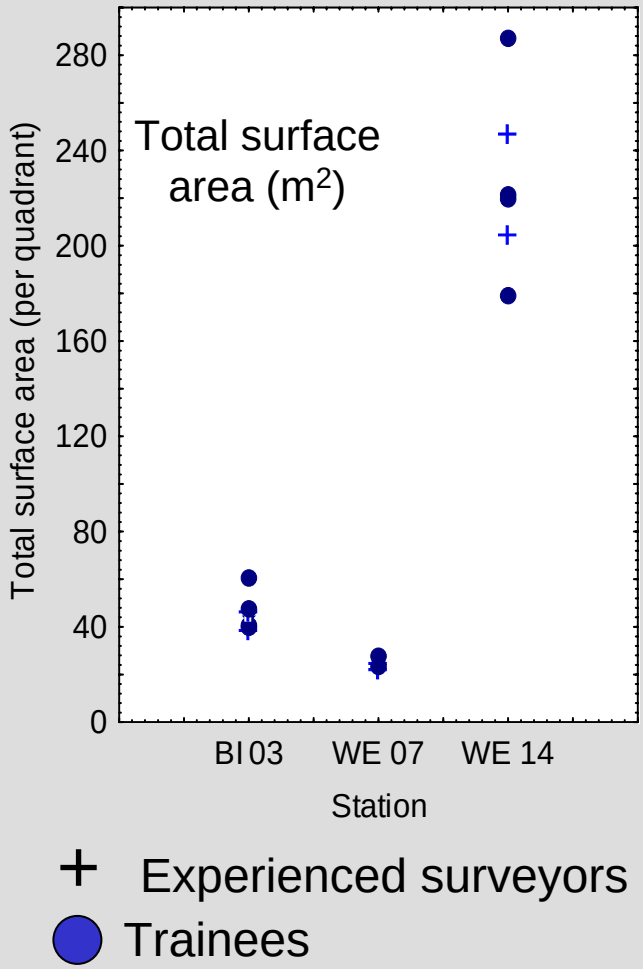
Sampling Unit Size



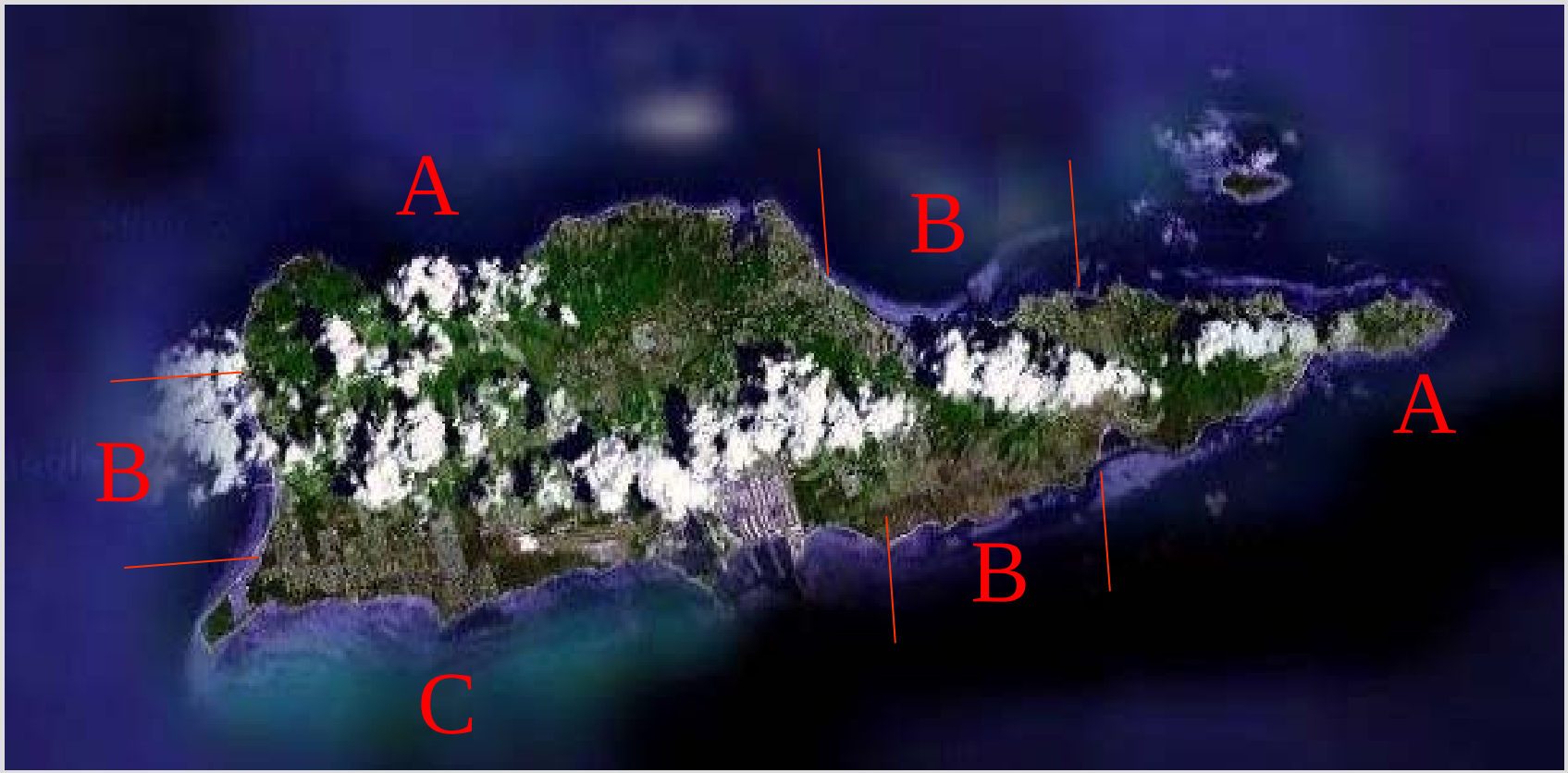
Compare precision at ¼, ½, ¾ and full-size transect

Test for different size sampling units along a response gradient

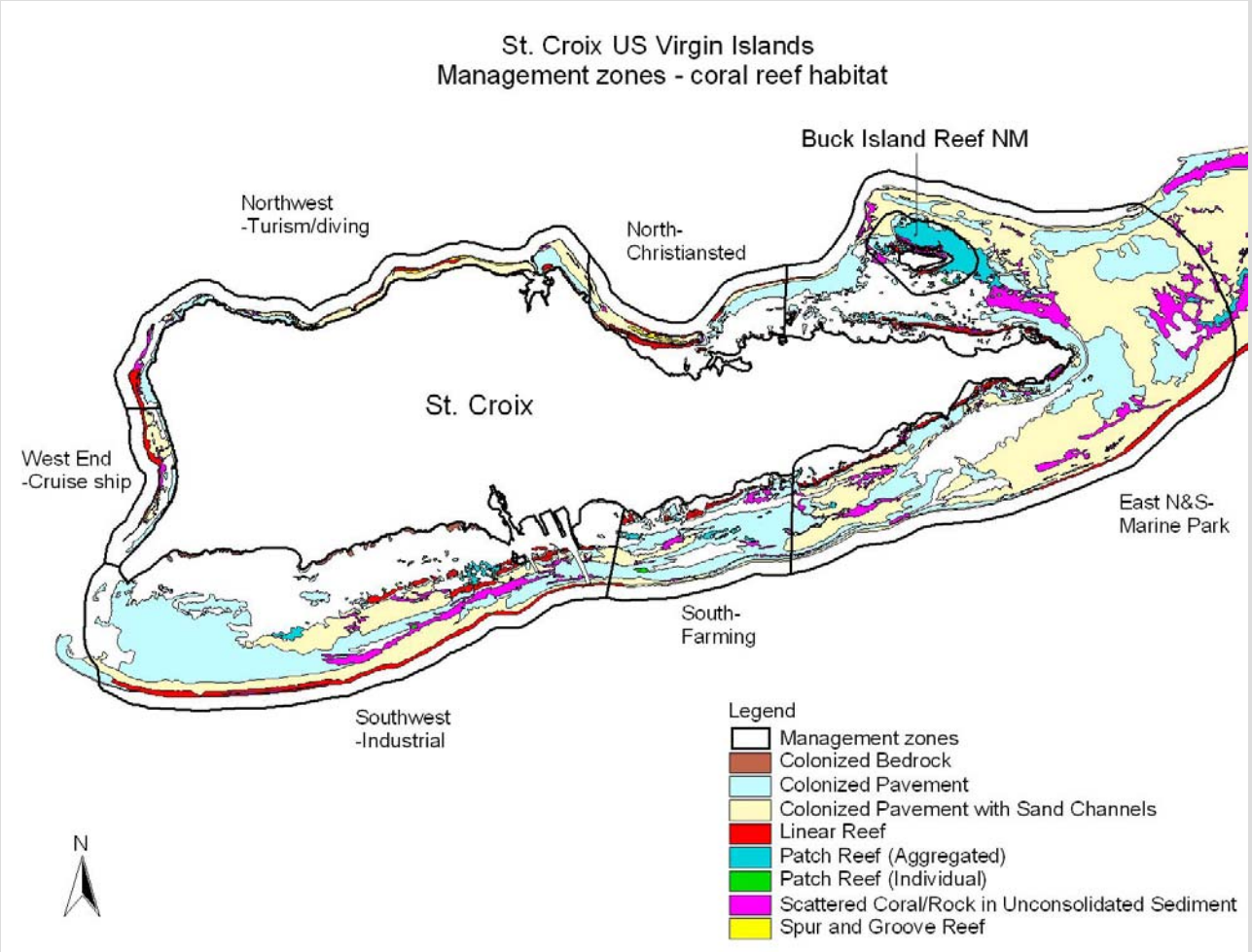
Protocol Technical Transfer



Management Zones



Reef Classifications



NOAA Benthic Maps

Reference Conditions

Remaining Survey Objectives

Finalize monitoring design

- Test metrics
- Final management zones and reef classifications
- Document variability (probability-based site selection)

Long-term Monitoring Strategy

Year	***1***	***2***	***3***	***4***	***5***
East St. Croix	10 trend 40 status				
West St. Croix		10 trend 30 status			
St. Thomas			10 trend 40 status		
St. John				10 trend 30 status	
Targeted	10	10	10	20	40
Total	**60**	**50**	**60**	**60**	**40**

Potential for Biocriteria

- Authority of CWA
- Legal framework
- Knowledge and expertise
- Existing monitoring programs
- Process for establishing scientifically defensible monitoring
- Desire to implement


Thank you!
fisher.william@epa.gov